*भारतीय मानक*

***Indian Standard***

**IS 3810 (Part 3) : 2023**

# ठोस खनिज ईंधन से संबंधित शब्दों की शब्दावली

## भाग 3 कोक

*( पहला पुनरीक्षण )*

# Glossary of Terms Relating to Solid Mineral Fuels

## Part 3 Coke

*( First Revision )*

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भारतीय मानक ब्यूरो
BUREAU OF INDIAN STANDARDS
मानक भवन, 9 बहादुर शाह ज़फर मार्ग, नई दिल्ली - 110002
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI - 110002
www.bis.gov.in www.standardsbis.in

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Solid Mineral Fuels and Solid Biofuels Sectional Committee, PCD 07

## FOREWORD

This Indian Standard (First Revision) was adopted by Bureau of Indian Standards after the draft finalized by the Solid Mineral Fuels and Solid Biofuels Sectional Committee had been approved by the Petroleum, Coal and Related Products Division Council.

This standard was originally published in 1966 as IS 3810 and was subsequently revised in 1977. In the first revision, the committee decided to enlarge the scope of the Indian Standard by formulating three parts:

Part 1 Coal and its preparation;

Part 2 Coal sampling and analysis; and

Part 3 Coke

The glossary of terms relating to coal and its preparation, earlier covered in IS 3810 : 1966 now forms Part 1 of this standard and is being revised with a view to align it with ISO 1213 'Vocabulary of term relating to solid mineral fuels'.

This standard (Part 3) consists of a list of terms commonly employed in the coke industry. Terms relating to sampling and analysis of coal are covered in Part 2 of the standard and may also be applied for coke with suitable modification, wherever necessary and have therefore, not been covered here to save repetition. In this standard, some of the terms have their equivalents shown in brackets; the use of such equivalents is deprecated.

In the present (first revision) of this Indian Standard, general terms like needle coke, formed coke, high reactivity coke, dry coke, CDCP/CDQ coke, CDCP/CDQ dust, and coke yield have been included in the glossary. High-Temperature properties are also included in this Indian Standard. Under physical analysis terms, a new term, Arithmetic Mean Size (AMS) with its calculation has been included. In this revision, certain definitions have also been modified.

The composition of the committee responsible for the formulation of this standard is listed in Annex A.

*Indian Standard*

# GLOSSARY OF TERMS RELATING TO SOLID MINERAL FUELS

## PART 3 COKE

*( First Revision )*

## 1 SCOPE

**1.1** This standard (Part 3) covers terms and definitions relating to coke.

**1.1.1** Terms and definitions relating to sampling and analysis of coal are given in Part 2 of this standard and may be used wherever necessary, with suitable modification.

## 2 REFERENCES

The standards listed below contain provisions which through reference in this text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards listed below:

| *IS No./ Other Publications* | *Title* |
|---|---|
| IS 439 : 2020 | Industrial coke — Specification (*fourth revision*) |
| IS 1354 : 1992 | Methods of test for coke — Special tests (*second revision*) |
| IS 4023 : 2022 | Methods for the determination of coke reactivity index (CRI) and coke strength after reaction (CSR) (*second revision*) |
| ISO 556 : 2020 | Coke (greater than 20 mm in size) — Determination of mechanical strength |

## 3 TERMINOLOGY

### 3.1 General

**3.1.1** *Coke* — The solid residue of the distillation of coal at high temperature (above 900 °C) in absence of air.

**3.1.2** *Foundry Coke* — Coke prepared in coke ovens usually in the size range of 80 mm to 30 mm for use in foundry cupola furnaces, usually large, and strong.

**3.1.3** *Wharf Coke* — Coke collected at the wharf of the coke ovens.

**3.1.4** *Skip Coke* — Coke collected at the discharge point of the skip car of the blast furnace.

**3.1.5** *Stabilized Coke* — Coke which has been subjected to a treatment of preparation before testing as prescribed in Annex A of IS 439.

**3.1.6** *Blast Furnace Coke* — Coke specially prepared in coke ovens for use in blast furnaces. It is divided based on the application in the blast furnace which is depends on working volume of blast furnace.

a) Blast furnace working volume $\geq$ 2 500 m$^3$ — Coke size in the range of 30 mm to 80 mm.

b) Blast furnace working volume < 2 500 m$^3$ — Coke size in the range of 25 mm to 80 mm.

**3.1.7** *Cauliflower End* — That portion of coke which comes in contact with the coke oven wall.

**3.1.8** *Centre of Even End (Spongy End)* — End of the coke piece corresponding to the centre line of cleavage.

**3.1.9** *Beehive Coke* — The solid residue of the distillation of coal in beehive coke ovens.

**3.1.10** *Low Temperature Coke* — The solid residue of low temperature distillation of coal (550 °C to 750 °C ).

**3.1.10** *Domestic Coke* — Coke produced by any process for domestic purposes.

**3.1.11** *Graded Coke* — Coke which has been screened between two specified sizes.

**3.1.12** *Needle Coke* — Needle coke is a kind of special coke, which presents a fibrous structure at optical microscope. It is recognized as an excellent carbon material with its unique physical and chemical properties. It is categorized as either coal pitch-based needle coke or petroleum pitch-based needle coke, is mainly used to produce high power electrodes and ultra-high-power electrodes.

**3.1.13** *Formed Coke* — Formed cokes are higher in their reactivity to $CO_2$, which means that they tend to affect degradation at high temperature. It is produced by two-stage process of cold or hot briquetting and the external or internal heating depending on the properties of raw material coals. Production of the formed coke from non-coking coal likes lignite, weakly coking coal and anthracite. The formation process mainly involves binding, briquetting, and coking. It is having a lower degree of homogeneity and arrangement of structure in comparison with conventional cokes.

**3.1.14** *High Reactivity Coke* — A process for the manufacture of highly reactive cokes which may be used in blast furnace.

**3.1.15** *Fine Coke (Breeze)* — Coke fine screenings from produced coke from the coke ovens. It is generally in the size range of 0 mm to 10 mm.

**3.1.16** *Small Coke (Pearl Coke)* — Coke generally in the size range of 10 mm to 25 mm.

**3.1.17** *Medium Coke (Nut Coke)* — Coke generally in the size range of 20 mm to 40 mm.

**3.1.18** *Mixed Coke* — Coke generally in the size range of 0 mm to 40 mm.

**3.1.19** *Large Coke* — Coke having size range of 25 mm to 100 mm.

**3.1.20** *Nut Coke* — Size of coke after segregating the blast furnace grade coke. It is divided based on the working volume of blast furnace.

a) Blast furnace working volume ≥ 2500 $m^3$ — Coke size in the range of 10 mm to 30 mm; and

b) Blast furnace working volume < 2500 $m^3$ — Coke size in the range of 10 mm to 25 mm.

**3.1.21** *Extra Large Coke* — Coke above 100 mm size.

**3.1.22** *Low Ash Metallurgical Coke* (*LAM Coke*) — Low ash metallurgical coke (LAM coke) is a solid carbonaceous material obtained from destructive distillation of low ash and low sulfur coals. It is obtained from recovery and non-recovery stamp charge industrial coke oven batteries.

**3.1.23** *CDCP/CDQ Coke* — Red hot coke from industrial coke oven batteries cooled with dry cooling media in presence of inert atmosphere called CDQ coke.

**3.1.24** *CDCP/CDQ Dust* — Coke fines generated by quenching of hot coke during dry quenching process.

**3.1.25** *Dry Coke* — Coke that has been dried to constant weight in accordance with definite prescribed methods.

**3.1.26** *Coke Yield* — Quantity of coke produced from one ton of coal/coal blend from coke making process. The determination of the coke yield by use of the formulas:

Calculation of coke yield from recovery stamp charge coke making:

$$Y_{cr} = [100 - (V_d + IM + BL) + V_{cd}]$$

where

$Y_{cr}$ = The percentage yield of coke;
$V_d$ = The percentage yield of volatile matter of coal/coal blend on ‘dry basis’;
$Vcd$ = Percentage yield of volatile matter of ‘dry’ coke;
$IM$ = The inherent moisture of coal blend; and
$BL$ = The burning loss during pushing and traveling of coke car from oven to quenching station (that is approximately 0.15 percent).

Calculation of coke yield from non-recovery stamp charge coke making:

$$Y_{cr} = [100 - (V_d + IM + BL) + V_{cd}]$$

where

$Ycr$ = Represent the percentage yield of coke;
$Vd$ = The percentage yield of volatile matter of coal/coal blend on ‘dry basis’;
$Vcd$ = Percentage yield of volatile matter of the ‘dry’ coke;
$IM$ = The inherent moisture of coal/coal blend; and
$BL$ = The burning loss (that is approximately 3.0 percent).

### 3.2 Size Analysis

**3.2.1** *Differential Size Analysis* — The division of a sample into size fractions with defined limits, the proportion of the fractions being expressed as percentages of the total sample, commonly with an indication of the percentage (and other characteristics, if required) of each fraction.

**3.2.2** *Cumulative Size Analysis* — The summation of two or more successive fractions retained on a particular screen size expressed as a percentage of the total mass.

**3.2.3** *Grading (Screening)* — The commercial operation of sorting coke between two screens, by causing one component to remain on the screen through which the other components pass.

**3.2.4** *Hand Shaking* — The operation in which a sieve is held in the hands and is given a horizontal oscillatory motion with a throw of about 75 mm.

**3.2.5** *Hand Placing* — The operation in which the screen remains stationary, and each piece of coke is handled, if a piece, in some position and without forcing, passes through the screen aperture it shall be considered as under size.

**3.2.6** *Mechanical Sieving* — The operation in which a set of sieves is agitated by mechanical means.

**3.2.7** *Struck Levelling* — A method of levelling the coke surface in a container when determining bulk density, whereby a straight edge is slid across the top of the container, any piece of coke which touches the straight edge being removed.

**3.3 Physical Properties**

**3.3.1** *Abrasion* — Particle size reduction caused by the rubbing of pieces of coke against each other or against a hard surface.

**3.3.2** *Breakage* — Particle size reduction resulting from impact.

**3.3.3** *Shatter Index* — The percentage of coke retained on a sieve of stated aperture after being subjected to the shatter test (*see* Fig 1 of IS 1354).

**3.3.4** *Micum Index* — The percentage of coke retained on a 40 mm test sieve or passing a 10 mm test sieve after being subjected to the standard micum test (*see* Fig 3 of IS 1354).

**3.3.5** *Arithmetic Mean Size (AMS)* — Coke determined by hand sizing the coke over a specific series of screen.

The arithmetic mean size of the coke was calculated from the size analysis of coke before and after the test. Let a, b, c, d….h, j, k be the complete series of sieve aperture used and A, B, C,…..H, J, K, be the cumulative percentage masses remaining on these sieves.

The arithmetic mean size of coke was calculated by using following formula :

$$AMS = \frac{\mathrm{B}(a-c)+\mathrm{C}(b-d)\ldots+\mathrm{J}(h-k)+100j}{200}, (mm)$$

where

$A = 0$ (the smallest sieve through which all the coke passes); and

$K = 100$ (that is K represent an imaginary sieve of zero aperture).

**3.3.6** *Irsid Test* — The percentage of coke retain on a 20 mm test sieve or passing a 10 mm test sieve after being subjected to standard Irsid test (*see* ISO 556).

**3.3.7** *Bulk Density* — The mass per unit volume occupied by a coke sample.

**3.3.8** *Relative Density (Apparent)* — The ratio of the mass of a volume of dry coke of any size to the mass of an equal volume of water at a specified temperature.

**3.3.9** *Porosity* — The volumetric proportion of voids within a piece of coke. The difference between the true relative density and the apparent relative density of a sample of coke expressed as percentage of the true relative density.

**3.4 High Temperature Properties**

**3.**4.1 *Coke Reactivity Index* — The percentage of coke mass remaining after reaction with $CO_2$ at 1 100 °C over a specific time interval after being subjected to the standard of coke strength after reaction (CSR) test (*see* of IS 4023).

**3.4.2** *Coke Strength After Reaction* — Strength of coke after exposed to high temperature and $CO_2$ atmosphere of the coke reactivity test, is subjected to a tumbler test to determine the CSR. The percentage of coke retained on 10 mm round sieve after being subjected to the standard (*see* of IS 4023).

## ANNEX A

(*Foreword*)

## COMMITTEE COMPOSITION

Solid Mineral Fuels and Solid Biofuels Sectional Committee, PCD 07

| *Organization* | *Representative(s)* |
|---|---|
| Central Institute for Mining and Fuel Research (CSIR-CIMFR), Dhanbad | Dr Suddhasatwa Basu (***Chairperson***) |
| Bharat Coking Coal Limited, Dhanbad | Shri V. K. Jha<br>Shri J. Dutta (*Alternate*) |
| Bharat Heavy Electrical Limited, Tiruchirapalli | Dr Sivaji Seepana<br>Shri Manda Teja Tarakesh (*Alternate* I)<br>Shri Aman Seraphim Surin (*Alternate* II)<br>Ms Aritra Chakraborty (*Alternate III*) |
| CSIR — Institute of Minerals and Materials Technology, Bhubaneswar | Dr Suddhasatwa Basu<br>Dr D. S. Rao (*Alternate* I)<br>Dr B. K. Nayak (*Alternate* II) |
| CSIR — National Metallurgical Laboratory (NML), Jamshedpur | Ms Sanchita Chakravarty<br>Ms Rupa Das Biswas (*Alternate*) |
| CSIR — Central Institute for Mining and Fuel Research (CIMFR), Dhanbad | Dr Ashok Kumar Singh<br>Dr Sujan Saha (*Alternate*) |
| Cement Manufacturer’s Association (CMA), New Delhi | Shri Gopal Gupta<br>Shri Raju Goyal (*Alternate* I)<br>Shri Aakash Gupta (*Alternate* II) |
| Central Electricity Authority (CEA), New Delhi | Shri S. K. Thakur<br>Shri L. D. Papney (*Alternate*) |
| Central Mine Planning & Design Institute Ltd (CMPDI), Ranchi | Shri N. Ramakrishan<br>Ms Zeba Imam (*Alternate*) |
| Central Pollution Control Board (CPCB), New Delhi | Shri Nazimuddin |
| Central Revenue Control Laboratory (CRCL), New Delhi | Dr T. A. Sreenivasa Rao |
| Coal Controller Organization, Kolkata | Shri Subhasis Sahu<br>Shri Anjani Kumar (*Alternate*) |
| Geological Survey of India (GSI), | Shri Biswajit Gangopadhyay |
| Kolkata Hindalco Industries Ltd, Mumbai | Shri Shouvik Majumdar<br>Shri Dipankar Khan (*Alternater*) |
| Indian Council of Agricultural Research (ICAR), New Delhi | Shri Kanchan Kumar Singh<br>Shri Anil Kumar Dubey (*Alternate*) |
| Indian Metals & Ferro Alloys Ltd. (IMFA), Bhubaneswar | Shri Dinesh Kumar Mohanty |
| Indian School of Mines (ISM), Dhanbad | Dr S. Bhattacharya |
| Mahanadi Coal Field Limited, Burla | Shri Ravikesh Kumar Raju<br>Shri Neeraj Kalla (*Alternate*) |
| Ministry of Coal, Department of Coal, New Delhi | Shri Anindya Sinha<br>Shri Piyush (*Alternate*) |

| *Organization* | *Representative(s)* |
|---|---|
| Ministry of Environment Forest and Climate Change, New Delhi | SHRI N. SUBRAHMANYAM |
| National Council for Cement & Building Materials (NCCBM), Faridabad | SHRI ANKUR MITTAL<br>SHRI GAURAV BHATNAGAR (*Alternate*) |
| Neyveli Lignite Corporation Limited (NLC Ltd), Neyveli | SHRI V. MANOHARAN |
| Northern Coalfields Limited (NCL), Singrauli | SHRI SATISH JHA |
| Research & Development Centre for Iron and Steel (RDCIS), SAIL, Ranchi | SHRI K. K. MANJHI<br>SHRI B. CHAKRABORTY (*Alternate*) |
| Singareni Collieries Company Limited (SCCL), Kothagudem | SHRI SYED HABEEB HUSSAIN |
| Tata Power Limited, Mumbai | SHRI PRAVASH SINHA |
| Tata Steel Limited, Kolkata | SHRI B. K. SINGH<br>SHRI H. N. PRASAD (*Alternate*) |
| The Energy and Resources Institute (TERI), New Delhi | SHRI SUNIL DHINGRA<br>SHRI N. K. RAM (*Alternate*) |
| In Personal Capacity (*A-304, 1st Floor, Defence Colony, New Delhi*) | SHRI S. K. GROVER |
| In Personal Capacity (*687, Baishnabghata Patuli, Ghoshpara xing on E M Bypass, Kolkata*) | DR KALYAN SEN |
| Directorate General, BIS | SHRIMATI NAGAMANI T, SCIENTIST 'E'/DIRECTOR AND HEAD (PETROLEUM, COAL AND RELATED PRODUCTS) [REPRESENTING DIRECTOR GENERAL (*Ex-officio*)] |

*Member Secretary*

MS ADITI CHOUDHARY
SCIENTIST 'B'/ASSISTANT DIRECTOR,
(PETROLEUM, COAL AND RELATED PRODUCTS), BIS

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## Amendments Issued Since Publication

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**BUREAU OF INDIAN STANDARDS**

**Headquarters:**

Manak Bhavan, 9 Bahadur Shah Zafar Marg, New Delhi 110002
*Telephones*: 2323 0131, 2323 3375, 2323 9402 *Website*: www.bis.gov.in

**Regional Offices:** *Telephones*

Central : 601/A, Konnectus Tower -1, 6th Floor, DMRC Building, Bhavbhuti Marg, New Delhi 110002 — 2323 7617

Eastern : 8th Floor, Plot No 7/7 & 7/8, CP Block, Sector V, Salt Lake, Kolkata, West Bengal 700091 — 2367 0012, 2320 9474

Northern : Plot No. 4-A, Sector 27-B, Madhya Marg, Chandigarh 160019 — 265 9930

Southern : C.I.T. Campus, IV Cross Road, Taramani, Chennai 600113 — 2254 1442, 2254 1216

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